JOINT TRANSPORTATION RESEARCH PROGRAM

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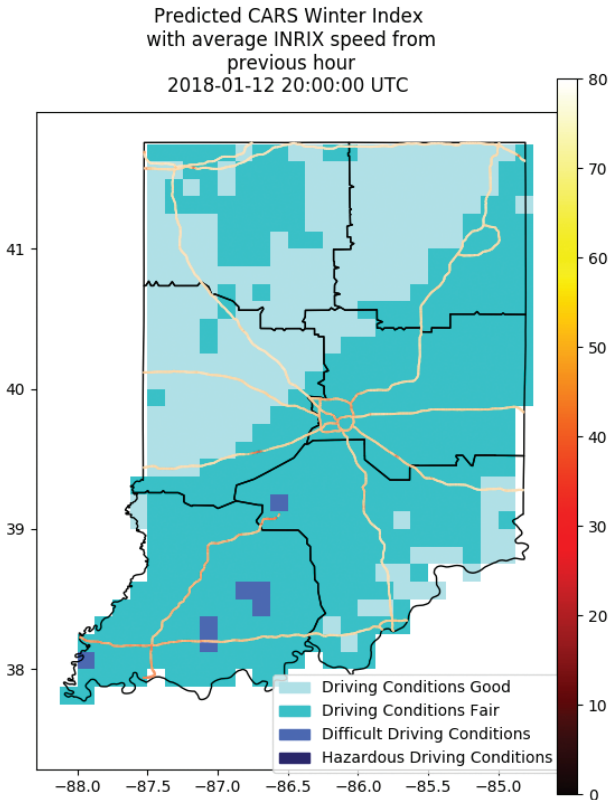
Automated Estimation of Winter Driving Conditions

Introduction

Real-time information regarding the status of the highway network has wide-ranging benefits. Knowledge of current traffic speeds, work zones, traffic cameras, and incident reports allows travelers to modify their routes and avoid potential hazards. In addition, operators of the transportation system rely heavily on such information to identify and verify incidents, manage winter maintenance resources, and issue advisories, resulting in improved safety and efficiency. INDOT uses numerous methods of communicating such information both internally and to the public, such as websites, “511” phone systems, and messaging signs. These systems have been evolving rapidly as new innovations are implemented, and customers have increasing expectations of continued advances.

It is critical for transportation agencies to be able to monitor conditions in real time as well as over the long term for purposes of maintenance, planning, and performance evaluation. INDOT uses the Condition Acquisition Reporting System (CARS) as a tool for communicating driving condition information along with weather-related impacts such as winter driving conditions, flooding, and weather warnings. During winter weather events, as staff observe conditions in real time, reports of winter driving conditions are submitted to CARS. There are practical limitations to this system since staff efforts during winter weather events are focused primarily on maintenance actions. During intense winter storms, it may be difficult for plow drivers and supervisors to report the driving condition. This provides motivation for this work in the development of automated tools that support the analysis and communication of information related to driving conditions.

There is great potential for improvements in traveler safety and satisfaction as new sources of information are incorporated into advanced analytics and prediction systems. In this project, we have developed innovative approaches to produce real-time estimates of winter driving conditions along with seasonal summaries of winter precipitation. High-fidelity weather information was integrated with CARS winter driving condition reports to develop a model that can accurately estimate driving conditions across the state based on weather variables. An experimental system was executed during the 2017–18 winter season to demonstrate the potential for automated estimates of driving conditions across Indiana. In addition, crowdsourced observations of winter precipitation were merged with standard observations at airports to generate high-quality seasonal analyses of winter precipitation frequency by type, such as snow and freezing rain.



Findings

- Several machine learning classification methods were tested and evaluated using a multi-year training data set. An experimental system was executed in real time during the 2017–18 winter season to demonstrate the potential for automated estimates of driving conditions across the state. A model based on the random forest approach was able to correctly classify examples from the test dataset at roughly 90% accuracy. The performance of this model fell to ~70% when applied to the 2017–18 season.
- Reduction in performance during the 2017–18 season was likely caused by "overfitting" to the 2014–16 data that was used to train the system, along with changes in the system used by the National Weather Service to provide short-term weather forecast information. Further research is needed to address these issues.
- In addition, crowdsourced observations of winter precipitation were merged with standard observations at airports to generate high-quality seasonal analyses of winter precipitation frequency by type, such as snow and freezing rain. These results provide a significant update to a recent Clear Roads study and contain a large number of observations that were unavailable in that previous study.

Implementation

The automated estimates for driving conditions will be refined as more information becomes available. A system for notifying INDOT staff of significant discrepancies between the current CARS reports and automated estimates will be implemented. This is a reasonable step between the current system and using the automated estimates as a "first guess" in the CARS reporting system. Monthly and seasonal analyses of winter precipitation types are available for planning and performance evaluation purposes via a web interface.

Recommended Citation for Report

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